GIS ANALYSES

Project Overview

The Geographic Information System (GIS) demonstration project within the Meramec River Watershed Inventory and Assessment effort was funded by the Environmental Protection Agency (EPA). The initial goal of the project was to produce many different large scale GIS layers for the Meramec River basin, thus providing the raw material for high quality natural resource inventory and analysis. The final objective of the project was to use the products of the analyses to prioritize wetlands for protection through acquisition or stream incentive programs. Much of the analytic techniques learned from these analyses will be used statewide for other river basin inventories.

The analytic phase of the project is already generating many new questions, some of which will lead to further analysis and/or more field work and subsequent analysis. One goal of this project is to further define the relationships between basin topography, land use in the basin and around the stream channel, and the effects they have on aquatic biota. Understanding and quantifying these relationships will give a basis for developing better management practices and provide information vital in dealing with many important conservation and water quality issues.

Analyses Overview

The following seven analyses were completed to answer wetland protection objectives, as well as various other management and research objectives:

- 1. Stream Prioritization
- 2. Watershed Landcover Prioritization
- 3. Stream Landcover Prioritization
- 4. Fish Nursery Wetlands
- 5. Wetland Prioritization
- 6. Fish Community Prioritization
- 7. Spectaclecase Mussel/ Slender Madtom

The prioritization analyses, Stream Prioritization, Watershed Landcover, Stream Landcover, Fish Nursery Wetlands, Wetland Prioritization, and Fish Community Prioritization, are directly concerned with wetland prioritization and protection. Protection could be either through acquisition or through landowner stream incentive programs, such as the Natural Resources Conservation Service (NRCS) Stream Buffer Conservation Reserve Program, or the MDC Alternate Watering Sources for Planned Grazing systems (part of the Stream Stewardship Program). Two other analyses, Spectaclecase Mussel Distribution and Slender Madtom Distribution are used to answer research questions. They will guide sampling efforts so researchers can better understand the distribution of species and identify the effects of various human activities on the aquatic resource.

While many of the analyses can be utilized independently to plan for protection, management, or research activities, consulting other analyses is recommended. Each prioritization analysis can be used as a decision making tool for incentives in the stream stewardship program.

1. Stream Prioritization

The stream prioritization analysis was performed to find stream segments near public land and near sites known as providing habitat for endangered species, or within spawning restricted reaches. The resulting selected set of 528 priority stream segments form only 5.6% of the 9,364 major stream segments for the basin. A series of seven GIS layers identifying either attractive features on or around the streams, such as springs or observed natural heritage species; or degrading features, such as chemical spill sites or mines, have been made available to further assess specific lands identified by any of the protection analyses.

Recommendation: Use of the results of this analysis is as a decision making tool for the biologist or planner who is assessing property for potential public land acquisition, or for prioritizing stream segments for incentive programs.

2. Watershed Landcover Prioritization

Landcover characterization was carried out to prioritize areas for acquisition or the stream incentive programs. Two analyses were done to provide a distributional measure of landcover within the watersheds and near the streams by combining either the Meramec Watershed stream network or the subwatershed layer with the Level 1 Landcover Classification of the Missouri Resource Assessment Partnership (MORAP).

The first analysis, watershed landcover prioritization, involved merging the project subwatershed layer with the landcover classification, and then rating the subwatersheds based on the percentages of certain landcover types, such as the Forest or Urban classes. Rated subwatersheds in order of most negatively impacted to the least negatively impacted watersheds were: Mattese Creek, Lower Lower Meramec. Lower Meramec Mainstem 5, Grand Glaise Creek, Fishpot Creek, Fishwater Creek, Dry Branch, Lower Courtois Creek, Billy's Branch, and Upper Indian Creek. Subwatersheds with greatest area of cropland from most to least were: LowMid Meramec main stem 6, Calvey Creek, LowMid Meramec main stem 3, Dry Fork main stem 1, and Lower Meramec main stem 6. Lastly, the subwatersheds with greatest area of grasslands were from most to least: Upper Dry Fork, Dry Fork main stem 1, Little Dry Fork, Spring Creek, and Norman Creek.

Recommendation: Rankings of the subwatersheds could be used by management to decide where to allocate monies from stream incentive programs. The cropland area totals indicate areas that could be targeted for corridor improvement funds, or in grassland areas, funds could be allocated toward cattle grazing management programs, such as the Alternative Watering Systems for Planned Grazing Systems program, this program gives a cost share for fencing off the stream and installing appropriate watering facilities for cattle managed in an intensive grazing system.

3. Stream Landcover Prioritization

The second analysis, stream landcover prioritization, involved merging the landcover classification with streams and a 90-meter buffer area around them to identify the landcover type percentages about the streams. The merged stream-landcover GIS layer enables biologist to identify with simple queries those places in the basin where extensive row crop agriculture is occurring in close proximity to the stream

channel. The relationship between cropland and streams varies among the subwatersheds, and significant reaches of unprotected streambanks can occur in any subwatershed with cropland. This analysis produced a data set with 70.98 kilometers (44.12 miles) of streams that have a high potential for being sources of sediment and farm chemicals, because they are adjacent to cropland and may have little or no corridor.

Recommendation: Stream segments with 50% or greater contact with cropland should be used to identify landowners who have little or no stream corridor on their land. Programs such as the MDC Stream Restoration Program or NRCS Stream Buffer Conservation Reserve Program could be used to assist landowner in creating and maintaining an effective corridor.

4. Fish Nursery Wetlands Identification

In this analysis, a set of potential fish nursery wetlands areas were selected. The results were used to provide one of the criteria for the Wetland Prioritization Analysis. The analysis utilized the National Wetland Inventory system of classes and modifiers to select among the many types of Palustrine wetlands. These selected wetlands were then reduced to those that have a direct connection to perennial streams to ensure juvenile fish could have access to the stream resource when they are mature. Field reconnaissance further determined the accuracy of potentially nursery areas. Out of these natural wetlands, only 398, or 2.5% of the total are inundated for extended periods. Out of these 398, 31 wetlands, which comprise only 0.12% of the total number of wetlands, had connectivity to perennial streams and were selected as potential fish nursery wetlands. Natural wetlands that might provide habitat for extended periods of time and have direct connection to water filled segments of the stream network, prove to be rare in the Meramec River basin.

Recommendation: Additional research needs to be done to determine additional wetland classes that function as fish nursery areas, and field work done to verify the fish nursery function of those selected classes.

5. Wetland Prioritization

Wetlands were rated according to a series of criteria that are based not only on the rarity or importance of the wetland type, but also on the local land use, as well as the proximity of the wetland to either beneficial areas (public land) or potentially degrading ones (encroaching urban areas). Rated wetlands had to be natural and Palustrine. Natural polygonal wetlands comprised 11.8% on public land (already protected), 43.6% within a mile of public land, 8.4% within a city limit, and 16.7% within a mile of a town. Thirteen protection area polygons encompassed the areas with the densest clumps of highly rated wetlands. These areas were, from largest wetland clusters to smallest wetland clusters and with a polygonal wetland rating, respectively, from 1-13: Saline Creek, Pacific, Eureka, Telegraph Road, Steelville, St. Clair, Salem, Crooked Creek, Scotts Ford/Riverview, The Eagle, Courtois/Lost Creek, Huzzah CA, Short Bend.

Recommendation: Suggested wetland protection areas should be targeted for acquisition or landowner enrollment in stream incentive programs because they contain the greatest concentrations of the most important wetlands.

6. Fish Community Prioritization

The Fish Community prioritization analysis was done to prioritize areas for protection, based on

differences in ecoregions, watersheds, fish sampling criteria, habitat considerations, and impact sources. A series of area "strata" were set up by dividing the basin using three sets of boundaries, Bailey's Ecoregion, NRCS 11-digit watershed units, and stream order of the subwatershed. Of the total of 28 strata created, only 22 were used. Criteria used for the analysis were 1) species richness, 2) habitat characteristics such as the presence of wetlands and springs, 3) public land, and 4) the presence of human impacts, such as mining sites or chemical dumping sites. The first analysis was a statistical analysis on the above data set. No correlation was found between the data sets. The second analysis used a ranking system (four to 18, the higher the value the more suitable the stratum) to determine which strata would be recommended for land acquisition. The highest score from the analysis was 16 for strata F. Thirteen strata received the scores of 12 or below, these areas were not considered for protection. The nine remaining strata above 12 were considered.

Recommendation: Three of these strata, Q, F, and J, were eliminated due to lack of fish sampling data, leaving six, U, S, G, B, H, and D, recommended for protection. More sampling should be carried out in stratum Q, F, and J to better determine protection potential.

7. Spectaclecase and Slender Madtom Distribution

Analyses were done to investigate the sampled range of aquatic habitat attribute values (stream order, gradient, miles to headwater) from collection sites making a "signature" for a species. These signatures were then used to select stream segments with the same attribute values in order to predict the potential range of the endangered spectaclecase mussel and the slender madtom. The spectaclecase sampled range was confined to the Meramec River from river mile 9.89 to 136.16, or a total of 126.27 stream miles. The predicted range using GIS was 167.86 stream miles, a potential range that was 32.9% greater than in length the sampled range. The predicted range of the slender madtom was extensive, 794.76 miles, or approximately 4.5 times the sampled range, which was 176.25 miles in extent.

Recommendation: Use the spectaclecase data to plan sampling work to fill in gaps in the data, especially between river mile 157.60 and 180.04, to see if populations are on higher reaches than the previously sampled populations. Use the slender madtom data to identify areas with few or no samples, and plan subsequent sampling excursions to identify the extent of the species range. The predicted range of the slender madtom included streams that need to be sampled within the Courtois Creek watershed: Courtois Creek between above Doss Branch (river mile 3.65) to below the confluence with Lost Creek (river mile 15.65), and the confluence of Indian Creek and upper Courtois Creek (river mile 30.77), the three major tributaries to Courtois, Lost Creek, Hazel Creek, and Cub Creek should be sampled higher in these creek's main stem. Also, the predicted range of the slender madtom included streams that need to be sampled within the Indian Creek watershed: Indian Creek from the confluence of Little Indian Creek (river mile 2.39) upstream to the confluence of Little Courtois Creek (river mile 11.40), between the confluences of Little Courtois Creek and the confluence of North Cut Branch on Indian Creek, and between the confluence of Simmsons Hollow and the confluence of Pinery Creek.

GIS DATA

General Data Descriptions

Streams

Watersheds

Springs

National Wetlands Inventory

General Data Descriptions

Streams

There are three different stream network files for the Meramec River wateshed. All three files feature a large set of attributes, including the USGS Hydrologic Unit hierarchy, three types of stream order classifications, county and topographic information, and Environmental Protection Agency (EPA) RF3 codes. Besides this common set of attributes, each file has a different purpose, and a different set of attributes beyond the common ones listed above.

The original full stream network file (mernetf) was digitized at 1:24,000 scale from Mylar separates provided by the Natural Resources Conservation Service (NRCS). It has all 1:24,000 streams and includes every stream/contour intersection, which allows gradient to be hard coded into the file.

Watersheds

The subwatershed file (mershed) was produced at 1:24,000 from topographic map separates. NRCS provided an early release of 14-Digit Hydrologic Unit files that corresponded roughly to counties. These files were edge matched (edited so their lines matched perfectly where two different files met), appended (put together), and subset to the study area (trimmed to the boundary of the study area). The intent of NRCS was to produce a series of evenly sized management areas based on drainages and applicable to their system of field offices, rather than a hydrologically strict set of true subwatersheds.

Lines were added increasing the number of subwatershed units from 42 to 103 while imposing stricter hydrological breaks. The breaks of the subwatersheds make them conform closely to the network of streams, and form a series of main stem subwatersheds which are broken at the confluences of any tributary having its own subwatershed.

Springs

The spring file (mersprf) has all 182 Meramec River watershed springs as points. Data from the stream file was joined to it, bringing along all of the attributes. Thus each spring carries the attributes of its spring branch. For example, if the branch is perennial, or has an RF3 code, that information is in the stream's record. The UTM X and Y coordinates of the spring point are also included. The distribution of the springs in the Meramec River basin is strongly related to the dolomitic rock formations of the Ozarks.

National Wetlands Inventory

The completed NWI files consist of two files that cover the entire 8-digit watershed. One file has point features (mrbnwip) and the other has polygon and line features (mrbnwic). The two files have been subset to the same extent as the 8-digit watershed boundary of the study area, matching the hydrologic organization of the rest of the files. The resulting polygon/line file is quite large (73 megabytes), so the coverages have been further subdivided into the 11-digit watershed boundaries. Any wetland that fell on

the boundary of two watersheds (mostly upland farm ponds) was included in the watershed that had the majority of the pond's area already inside it.

The 1:24,000 National Wetlands Inventory data set is the most detailed data set available for water bodies. The existing 1:100,000 water body file, extracted from Digital Line Graph files (DLG) has a total of only 188 water bodies represented for the Meramec River basin with a minimum size of just over an acre. In contrast, the NWI data set has 19,120 polygonal wetlands with a minimum size of 1/10th of an acre, and 3,345 smaller wetlands designated by points. Though not all polygonal wetlands are water bodies, the wetlands that carry the classifications PUBGh and PUBFh, are farm ponds. According to NWI, there are 13,241 of these water bodies in the watershed. This is quite an improvement over the 188 water bodies from the DLG's.

For more information contact:

Mark Caldwell, GIS Specialist

Missouri Department of Conservation

Conservation Research Center

1110 S. College Avenue

Columbia, Missouri 65201